

# SPATIAL ANALYSIS WINTER 2023

## GEOG 318 / PLAN 353 / GEOG 318 / PLAN 353

Published Jan 12, 2023

### CLASS SCHEDULE

Section	Location	Time	Instructor(s)
GEOG 318 001 [LEC]	EV2 2002	Fridays 12:30 p.m. - 2:20 p.m.	Derek Robinson dtrobinson@uwaterloo.ca
PLAN 353 001 [LEC]		Fridays 12:30 p.m. - 2:20 p.m.	
GEOG 318 101 [LAB]	EV2 1002A	Mondays 8:30 a.m. - 10:20 a.m.	
GEOG 318 102 [LAB]		Mondays 10:30 a.m. - 12:20 p.m.	
PLAN 353 101 [LAB]		Mondays 8:30 a.m. - 10:20 a.m.	
PLAN 353 102 [LAB]		Mondays 10:30 a.m. - 12:20 p.m.	

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### INSTRUCTOR / TA INFORMATION

Instructor: Derek T. Robinson  
Email: dtrobinson@uwaterloo.ca  
Office hours: Available upon request via email.

TA: Dora Liu  
Email: dora.liu@uwaterloo.ca

### COURSE DESCRIPTION

#### Calendar Description for GEOG 318

Advanced quantitative analysis in a spatial context. A selection of techniques from sampling, geostatistics, point pattern analysis and cluster detection, spatial classification, and spatial data mining.

Prereq: ENVS 278; Not open to students in the Faculty of Mathematics

#### Calendar Description for PLAN 353

Advanced quantitative analysis in a spatial context. A selection of techniques from sampling, geostatistics, point pattern analysis and cluster detection, spatial classification, and spatial data mining.

Prereq: ENVS 278; Not open to students in the Faculty of Mathematics

#### Calendar Description for GEOG 318

Advanced quantitative analysis in a spatial context. A selection of techniques from sampling, geostatistics, point pattern analysis and cluster detection, spatial classification, and spatial data mining.

Prereq: ENVS 278; Not open to students in the Faculty of Mathematics

#### Calendar Description for PLAN 353

Advanced quantitative analysis in a spatial context. A selection of techniques from sampling, geostatistics, point pattern analysis and cluster detection, spatial classification, and spatial data mining.

Prereq: ENVS 278; Not open to students in the Faculty of Mathematics

Spatial analysis techniques are developed and applied in diverse fields such as geography, spatial epidemiology, spatial econometrics, geocomputation, and spatial statistics to explain and predict spatial phenomena. Today, spatial analysis is mainly based on statistical techniques and geoprocessing using geographic information systems (GIS). The spatial character of data implies several methodological challenges in spatial data analysis especially related to the spatial dependence of the data, which often invalidates non-spatial modeling and evaluation approaches and leads to special techniques for spatial sampling and spatial regression modeling.

Geography 318 (cross listed with Planning 353) gives an overview of statistical and computational techniques for spatial regression modeling, spatial classification, spatial interpolation, and point pattern analysis. In addition, selected topics such as spatial data mining and spatial analysis software may be addressed, depending upon the progress of the course. Several real-world applications of spatial analysis techniques will be discussed and provide context for course assignments.

## LEARNING OUTCOMES

**By the end of this course students should be able to:**

understand and recognize the potential and pitfalls of spatial analysis
develop a general understanding of a variety of spatial modelling techniques
interpret and critically discuss spatial models and their results

## TENTATIVE COURSE SCHEDULE

The course comprises lecture content and dedicated lab work on assignments. The lecture will be used to introduce the theory and concepts behind spatial analysis methods as well as to demonstrate techniques that will aid the completion of lab assignments. Significant additional time will be required for independent study to complete assignments and develop necessary skills (see also section *Getting Help* below). The schedule of course content and due dates are subject to change.

Class	Week	Contents	Chapters
1	Jan 13	Introduction to Spatial Analysis	1, 2
2	Jan 20	Maps as Outcomes of Processes	3, 4
3	Jan 27	Point Pattern Analysis	5
4	Feb 3	Point Pattern Analysis, Area Objects, and Spatial Autocorrelation	6, 7
5	Feb 10	Local Statistics	7, 8
	Feb 17	Describing and Analyzing Fields	9
6	Feb 24	<b>Reading Week</b>	
7	Mar 3	Describing and Analyzing Fields	9, 10
8	Mar 10	The Statistics of Fields	10
9	Mar 17	Putting Maps Together	11
10	Mar 24	Landscape Metrics and Applications of Spatial Analysis	
11	Mar 30	New Approaches to Spatial Analysis	12
12	April 10	Review Session	

## TEXTS / MATERIALS

Title / Name	Notes / Comments	Required
O'Sullivan, D. and D. Unwin, 2010. Geographic Information Analysis, 2nd Edition, Wiley. Available online through the library.	You should find free pdf access to this book through the UWaterloo library.	Yes
Lloyd, C.D., 2010. Spatial Data Analysis: an Introduction for GIS Users. Oxford Univ. Press.		No
Burrough, P.A., McDonnell, R.A., and C.D. Lloyd, 2015. Principles of Geographical Information Systems. Oxford University Press.		No
De Smith, M.J., Goodchild, M.F., and P.A. Longley, 2006. Geospatial Analysis, Troubador Publications. Available online at <a href="http://www.spatialanalysisonline.com/output/">http://www.spatialanalysisonline.com/output/</a>		No

Potential link to course textbook.

[https://ocul-wtl.primo.exlibrisgroup.com/discovery/fulldisplay?](https://ocul-wtl.primo.exlibrisgroup.com/discovery/fulldisplay?docid=alma992914887105151&context=L&vid=01OCUL_WTL:WTL_DEFAULT&lang=en&search_scope=OCULDiscoveryNetwork&adaptor=Local%20Search%20Engine&isFr)

[docid=alma992914887105151&context=L&vid=01OCUL\\_WTL:WTL\\_DEFAULT&lang=en&search\\_scope=OCULDiscoveryNetwork&adaptor=Local%20Search%20Engine&isFr](https://ocul-wtl.primo.exlibrisgroup.com/discovery/fulldisplay?docid=alma992914887105151&context=L&vid=01OCUL_WTL:WTL_DEFAULT&lang=en&search_scope=OCULDiscoveryNetwork&adaptor=Local%20Search%20Engine&isFr)

## STUDENT ASSESSMENT

Component	Value
Assignments	65%
Final Exam	35%

The course has been restructured for online distribution with the aim of having weekly assignments that collectively account for 65% of the course content. These assignments will be completed online using a combination of LEARN and Jupyter Notebooks and R Statistics for completion. Assignments will commence in the second week of the course but the first week will require students to setup a workflow for using Jupyter Notebooks on the Math Faculty Jupyter Hub, which can be found here: <https://jupyter.math.uwaterloo.ca/hub/login> (<https://jupyter.math.uwaterloo.ca/hub/login>)

There are no serious programming requirements or extensive prior knowledge of geographic information systems to complete the assignments in this course. The notebooks will guide you through the technical steps and students will adjust notebook content/code to improve their understanding about the statistical and spatial analysis concepts discussed in the course.

Assignments are due on the date and at the time posted on LEARN. Assignments will be subjected to a 10% reduction in the acquired score for each day that they are late up to 3 days and then a value of zero will be assigned for the entire assignment. An assignment submitted even one minute after the deadline will be considered late by one day. Therefore, if you received an 80% on an assignment submitted one day late, then you would acquire a final score of 72% with the 10% penalty applied.

**Due dates may be altered and updated as the term progresses. Changes to the schedule will be notified to the class via the LEARN Announcements and via MS Teams as well as with an updated Syllabus posted on LEARN.**

A course website has been created on the learning platform "Learn" (Desire2Learn). Information on access to the website will be provided in class. Students registered in the course can access the course website after the first class by going to the LEARN website (<http://learn.uwaterloo.ca> (<http://learn.uwaterloo.ca>)) and logging in using your WatIAM/Quest username and password. Once logged in, you will see the course listed under "My Courses and Communities". Click on GEOG 318/353 to see the course content.

The course website provides access to lecture presentations, course notes, and other relevant information. Online material in LEARN can be opened or downloaded by clicking on the appropriate link. In addition, the course website supports announcements, discussion groups and e-mail. Assignments will be handed in via the LEARN course website and students should become familiar with the website and submission process early so as not to receive a late submission.

## ASSIGNMENT SCREENING

Text matching software (Turnitin) will be used to screen assignments in this course. This is being done to verify that use of all material and sources in assignments is documented. In the first week of the term, details will be provided about the arrangements for the use of Turnitin and alternatives in this course. See Administrative Policy below for more information and links.

## NOTICE OF RECORDING

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Activities for this course may involve recording, in partial fulfillment of the course learning outcomes. You will receive notification of recording via at least one of the following mechanisms: within the Learning Management System (LEARN), a message from your course instructor, course syllabus/website, or other means. Some technologies may also provide a recording indicator. Images, audio, text/chat messaging that have been recorded may be used and/or made available by the University to GEOG 318/PLAN 353 instructors, teaching assistants, and students for the purpose of materials review. Recordings will be managed according to the University records classification scheme, [WatClass](https://uwaterloo.ca/records-management/records-classification-and-retention-schedules/) (<https://uwaterloo.ca/records-management/records-classification-and-retention-schedules/>), and will be securely destroyed when no longer needed by the University. Your personal information is protected in accordance with the [Freedom of Information and Protection of Privacy Act](https://www.ontario.ca/laws/statute/9of31) (<https://www.ontario.ca/laws/statute/9of31>), as well as [University policies and guidelines](https://uwaterloo.ca/privacy/) (<https://uwaterloo.ca/privacy/>) and may be subject to disclosure where required by law.

The University will use reasonable means to protect the security and confidentiality of the recorded information, but cannot provide a guarantee of such due to factors beyond the University's control, such as recordings being forwarded, copied, intercepted, circulated, disclosed, or stored without the University's knowledge or permission or the introduction of malware into computer system which could potentially damage or disrupt the computer, networks, and security settings. The University is not responsible for connectivity/technical difficulties or loss of data associated with your hardware, software or Internet connection.

By engaging in course activities that involve recording, you are consenting to the use of your appearance, image, text/chat messaging, and voice and/or likeness in the manner and under the conditions specified herein. (In the case of a live stream event, if you choose not to have your image or audio recorded, you may [disable the audio and video functionality](https://uwaterloo.ca/student-it-services/) (<https://uwaterloo.ca/student-it-services/>). Instructions to participate using a pseudonym instead of your real name are included where the feature exists; however, you must disclose the pseudonym to your instructor in advance in order to facilitate class participation.) If you choose not to be recorded, this notice serves as confirmation of your understanding that you must seek an alternative arrangement with the course instructor.

You are not permitted to disclose the link to/URL of an event or an event session recording or copies of recording to anyone, for any reason. Recordings are available only to authorized individuals who have been directly provided the above instructions/link for their use. Recordings for personal use, required to facilitate your learning and preparation of personal course/lecture notes, should not be shared with others without the permission of the instructor or event coordinator. Review the University's [guidelines for faculty, staff and students entering relationships with external organizations offering access to course materials](https://uwaterloo.ca/secretariat/faculty-staff-and-students-entering-relationships-external) (<https://uwaterloo.ca/secretariat/faculty-staff-and-students-entering-relationships-external>) for more information on your obligations with respect to keeping copies of course materials. For more information about accessibility, connect with [AccessAbility Services](https://uwaterloo.ca/accessability-services/) (<https://uwaterloo.ca/accessability-services/>).

## ADMINISTRATIVE POLICY

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### Community of Learners

A goal for this course is that we shall all contribute to a climate that promotes a Community of Learners. This includes participating in an instructional environment that promotes respect, interaction, and communication. Respectful language and behaviour are expected of all students during classes and class discussions.

Please Note: In a community of learners, diversity of opinion is respected. Class discussions, group exercises, etc., should reflect respect for others' opinions. If you anticipate an emergency during the class meeting that will require the activation of your cell phone and/or device please speak with the instructor before class. Otherwise, please respect the instructional environment that is interrupted if cell phones or devices are activated.

**Intellectual Property:** For further information on IP related to teaching, please see [https://uwaterloo.ca/legal-and-immigration-services/sites/ca.legal-and-immigration-services/files/uploads/files/volume\\_1\\_issue\\_3\\_winter\\_2018.pdf](https://uwaterloo.ca/legal-and-immigration-services/sites/ca.legal-and-immigration-services/files/uploads/files/volume_1_issue_3_winter_2018.pdf) ([https://uwaterloo.ca/legal-and-immigration-services/sites/ca.legal-and-immigration-services/files/uploads/files/volume\\_1\\_issue\\_3\\_winter\\_2018.pdf](https://uwaterloo.ca/legal-and-immigration-services/sites/ca.legal-and-immigration-services/files/uploads/files/volume_1_issue_3_winter_2018.pdf)) and the Guidelines for Faculty, Staff and Students Entering Relationships with

External Organizations Offering Access to Course Materials, <https://uwaterloo.ca/secretariat/faculty-staff-and-students-entering-relationships-external> (<https://uwaterloo.ca/secretariat/faculty-staff-and-students-entering-relationships-external>) . The following text is recommended:

Students should be aware that this course contains the intellectual property of their instructor, TA, and/or the University of Waterloo. Intellectual property includes items such as:

- Lecture content, spoken and written (and any audio/video recording thereof);
- Lecture handouts, presentations, and other materials prepared for the course (e.g., PowerPoint slides);
- Questions or solution sets from various types of assessments (e.g., assignments, quizzes, tests, final exams); and
- Work protected by copyright (e.g., any work authored by the instructor or TA or used by the instructor or TA with permission of the copyright owner).

Course materials and the intellectual property contained therein, are used to enhance a student's educational experience. However, sharing this intellectual property without the intellectual property owner's permission is a violation of intellectual property rights. For this reason, it is necessary to ask the instructor, TA and/or the University of Waterloo for permission before uploading and sharing the intellectual property of others online (e.g., to an online repository).

Permission from an instructor, TA or the University is also necessary before sharing the intellectual property of others from completed courses with students taking the same/similar courses in subsequent terms/years. In many cases, instructors might be happy to allow distribution of certain materials. However, doing so without expressed permission is considered a violation of intellectual property rights.

Please alert the instructor if you become aware of intellectual property belonging to others (past or present) circulating, either through the student body or online. The intellectual property rights owner deserves to know (and may have already given their consent).

**Intellectual Property:** For further information on IP related to teaching, please see [https://uwaterloo.ca/legal-and-immigration-services/sites/ca.legal-and-immigration-services/files/uploads/files/volume\\_1\\_issue\\_3\\_winter\\_2018.pdf](https://uwaterloo.ca/legal-and-immigration-services/sites/ca.legal-and-immigration-services/files/uploads/files/volume_1_issue_3_winter_2018.pdf) ([https://uwaterloo.ca/legal-and-immigration-services/sites/ca.legal-and-immigration-services/files/uploads/files/volume\\_1\\_issue\\_3\\_winter\\_2018.pdf](https://uwaterloo.ca/legal-and-immigration-services/sites/ca.legal-and-immigration-services/files/uploads/files/volume_1_issue_3_winter_2018.pdf)) and the Guidelines for Faculty, Staff and Students Entering Relationships with External Organizations Offering Access to Course Materials, <https://uwaterloo.ca/secretariat/faculty-staff-and-students-entering-relationships-external> (<https://uwaterloo.ca/secretariat/faculty-staff-and-students-entering-relationships-external>) . The following text is recommended:

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**Anti-racism Statement:** The University of Waterloo does not tolerate racism or any other form of discrimination and expects campus community members to contribute to a culture where all members feel safe and valued. Any member of the campus community who has experienced racism or discrimination at the University is encouraged to seek guidance from the Office of Equity, Diversity, Inclusion & Anti-racism (EDI-R) via email at [equity@uwaterloo.ca](mailto:equity@uwaterloo.ca) (<mailto:equity@uwaterloo.ca>) or through their website: [uwaterloo.ca/human-rights-equity-inclusion/about/equity-office3](https://uwaterloo.ca/human-rights-equity-inclusion/about/equity-office3)

**Co-op interviews and class attendance:** Co-op students are encouraged to try and choose interview time slots that result in the least amount of disruption to class schedules. When this is challenging, or not possible, a student may miss a portion of a class meeting for an interview. Instructors are asked for leniency in these situations; but, a co-op interview does not relieve the student of any requirements associated with that class meeting.

When a co-op interview conflicts with an in-class evaluation mechanism (e.g., test, quiz, presentation, critique), class attendance takes precedence and the onus is on the student to reschedule the interview. CEE provides an interview conflict procedure to manage these situations.

Students will be required to provide copies of their interview schedules (they may be printed from WaterlooWorks) should there be a need to verify class absence due to co-op interviews.

**Declaring an absence:** Regardless of the process used to declare an absence, instructors maintain agency over decisions regarding course component accommodations.

Self-declared absences (for flu-like illness, short-term 48 hour self declared absences) must be submitted through Quest.

Absences requiring documentation (e.g. Verification of Illness Form, bereavement, etc.) - send your documentation to [env-vif@uwaterloo.ca](mailto:env-vif@uwaterloo.ca). Do not send documentation to your advisor, course instructor, teaching assistant, or lab coordinator. Submission to [env-vif@uwaterloo.ca](mailto:env-vif@uwaterloo.ca) () will notify all of your instructors of your absence. Students taking courses in Arts that require accommodation, should reach out to those instructors independently.

**Mental Health:** The University of Waterloo, the Faculty of Environment and our Departments/Schools consider students' well-being to be extremely important. We recognize that throughout the term students may face health challenges - physical and / or emotional. **Please note that help is available.** Mental health is a serious issue for everyone and can affect your ability to do your best work. Counselling Services <https://uwaterloo.ca/campus-wellness/> (<https://uwaterloo.ca/campus-wellness/>) is an inclusive, non-judgmental, and confidential space for anyone to seek support. They offer confidential counselling for a variety of areas including anxiety, stress management, depression, grief, substance use, sexuality, relationship issues, and much more.

All students are encouraged to download the WatSAFE app which is available free through the google and iOS app stores. The WatSAFE app provides on- and off-campus contacts for students in distress, including international students, and other information related to campus safety and security.

**Religious Observances:** Students need to inform the instructor at the beginning of term if special accommodation needs to be made for religious observances that are not otherwise accounted for in the scheduling of classes and assignments.

**Communications with Instructor and Teaching Assistants:** All communication with students must be through either the student's University of Waterloo email account or via LEARN. If a student emails the instructor or TA from a personal account they will be requested to resend the email using their personal University of Waterloo email account.

**Recording lecture:** Use of recording devices during lectures is only allowed with explicit permission of the instructor of the course. If allowed, video recordings may only include images of the instructor and not fellow classmates. Posting of videos or links to the video to any website, including but not limited to social media sites such as: facebook, twitter, etc., is strictly prohibited.

## UNIVERSITY POLICY

**Academic integrity:** In order to maintain a culture of academic integrity, members of the University of Waterloo community are expected to promote honesty, trust, fairness, respect and responsibility. [Check [the Office of Academic Integrity](https://uwaterloo.ca/academic-integrity/) (https://uwaterloo.ca/academic-integrity/) for more information.]

**Grievance:** A student who believes that a decision affecting some aspect of their university life has been unfair or unreasonable may have grounds for initiating a grievance. Read [Policy 70, Student Petitions and Grievances, Section 4](https://uwaterloo.ca/secretariat/policies-procedures-guidelines/policy-70) (https://uwaterloo.ca/secretariat/policies-procedures-guidelines/policy-70) . When in doubt, please be certain to contact the department's administrative assistant who will provide further assistance.

**Discipline:** A student is expected to know what constitutes academic integrity to avoid committing an academic offence, and to take responsibility for their actions. [Check [the Office of Academic Integrity](https://uwaterloo.ca/academic-integrity/) (https://uwaterloo.ca/academic-integrity/) for more information.] A student who is unsure whether an action constitutes an offence, or who needs help in learning how to avoid offences (e.g., plagiarism, cheating) or about "rules" for group work/collaboration should seek guidance from the course instructor, academic advisor, or the undergraduate associate dean. For information on categories of offences and types of penalties, students should refer to [Policy 71, Student Discipline](https://uwaterloo.ca/secretariat/policies-procedures-guidelines/policy-71) (https://uwaterloo.ca/secretariat/policies-procedures-guidelines/policy-71) . For typical penalties, check [Guidelines for the Assessment of Penalties](https://uwaterloo.ca/secretariat/guidelines/guidelines-assessment-penalties) (https://uwaterloo.ca/secretariat/guidelines/guidelines-assessment-penalties) .

**Appeals:** A decision made or penalty imposed under [Policy 70, Student Petitions and Grievances](https://uwaterloo.ca/secretariat/policies-procedures-guidelines/policy-70) (https://uwaterloo.ca/secretariat/policies-procedures-guidelines/policy-70) (other than a petition) or [Policy 71, Student Discipline](https://uwaterloo.ca/secretariat/policies-procedures-guidelines/policy-71) (https://uwaterloo.ca/secretariat/policies-procedures-guidelines/policy-71) may be appealed if there is a ground. A student who believes they have a ground for an appeal should refer to [Policy 72, Student Appeals](https://uwaterloo.ca/secretariat/policies-procedures-guidelines/policy-72) (https://uwaterloo.ca/secretariat/policies-procedures-guidelines/policy-72) .

**Note for students with disabilities:** [AccessAbility Services](https://uwaterloo.ca/disability-services/) (https://uwaterloo.ca/disability-services/) , located in Needles Hall, Room 1401, collaborates with all academic departments to arrange appropriate accommodations for students with disabilities without compromising the academic integrity of the curriculum. If you require academic accommodations to lessen the impact of your disability, please register with AccessAbility Services at the beginning of each academic term.

**Turnitin.com:** Text matching software (Turnitin®) may be used to screen assignments in this course. Turnitin® is used to verify that all materials and sources in assignments are documented. Students' submissions are stored on a U.S. server, therefore students must be given an alternative (e.g., scaffolded assignment or annotated bibliography), if they are concerned about their privacy and/or security. Students will be given due notice, in the first week of the term and/or at the time assignment details are provided, about arrangements and alternatives for the use of Turnitin in this course.

It is the responsibility of the student to notify the instructor if they, in the first week of term or at the time assignment details are provided, wish to submit alternate assignment.